7301-EN-01
DTIC

DEVELOPMENT OF AN INUNDATION MAPPING CAPABILITY USING HIGH RESOLUTION FINITE ELEMENT MODELLING

by

C. SMITH, P.D. BATES and M.G. ANDERSON

Interim Report 006
June 1996

19970909 122

United States Army

European Research Office of the U.S. Army
London, England

CONTRACT NUMBER N681710-94-C-9109

Professor M G Anderson

Approved for Public Release: distribution unlimited

DTIC QUALITY INSPECTED 3

USACE report - June 1996

Current Position

Since the previous report the long awaited topographic data for the Gavins Point to Maskell reach has now been received. The data consists of 343 cross sections of the river bed, on average the sections are spaced about every 150 metres and contain about 100 data points (depending on section length). With this data the model shall become fully operational for flow simulation in the next few weeks. It should also allow the stage data at Yankton and Gayville to be used for rigorous calibration as proposed in the previous report. The processes that have been necessary in applying the new topographic data to the model are outlined in this report as are the outstanding future steps and problems at this time.

With both the model and the data based on the UTM (Universal Transverse Mercator) co-ordinate system a very close spatial match was apparent. This allowed the data to be directly applied to the model with only minor modifications necessary to the model boundaries and topographic cross sections.

New finite element meshes have been created for the new model boundaries. The resolution of these can vary and several shall be produced. Ideally a high resolution mesh would be used over the entire reach to fully utilise the very high quality topographic data. This is however not usually practical because of the very long computational times involved. Meshes can however be created that have varying resolution along the length of the reach so specific areas can be examined in detail, whilst maintaining the accurate boundary conditions at the two end gauge stations. This and a moderate resolution (element size about 100m) full reach mesh (Figure 1) would seem to be the best methods of attaining the required results.

Before the model can be used the cross section data must be converted into elevation values at each node point in the computational domain. In the past this has been done using an interpolation package with the model. The method is based on the nearest

data points in quadrants around the node point and weighting for distance. This method is good for an even covering of data points but cross section data causes some interpolation irregularities to show up. A new interpolation program was therefore written to overcome this problem and maximise the utility of the high quality data set. The new method is based on directional downstream interpolation between cross sections. It shows improvements over the original method in the definition of both the deep water channel and dry areas within the domain. The topography created using the new interpolation method is shown in Figures 2-4 (for the mesh in Figure 1).

A significant problem with the flow data record has recently been identified. The datum level for the Maskell gauge site (the model downstream boundary) has been given as 1124.1 feet. However when this value is added to the measured stage values, of about 23 feet, the water surface elevation values are about 20 feet higher than expected (when compared to USGS maps). This error leads to the water surface elevations at Maskell to be higher than those further up the reach at Gayville! An approximate correction factor can be applied temporarily but ideally the datum level or stage values should be checked and validated.

Currently the moderate resolution version of the model (Figure 1) is being run towards a stable steady state condition from which dynamic simulations shall be launched. The dynamic simulation of sections of the flow record from summer 1993 shall be started within the next month.

Future Work

The following tasks will be undertaken:

1. Attain steady state conditions for the model illustrated.

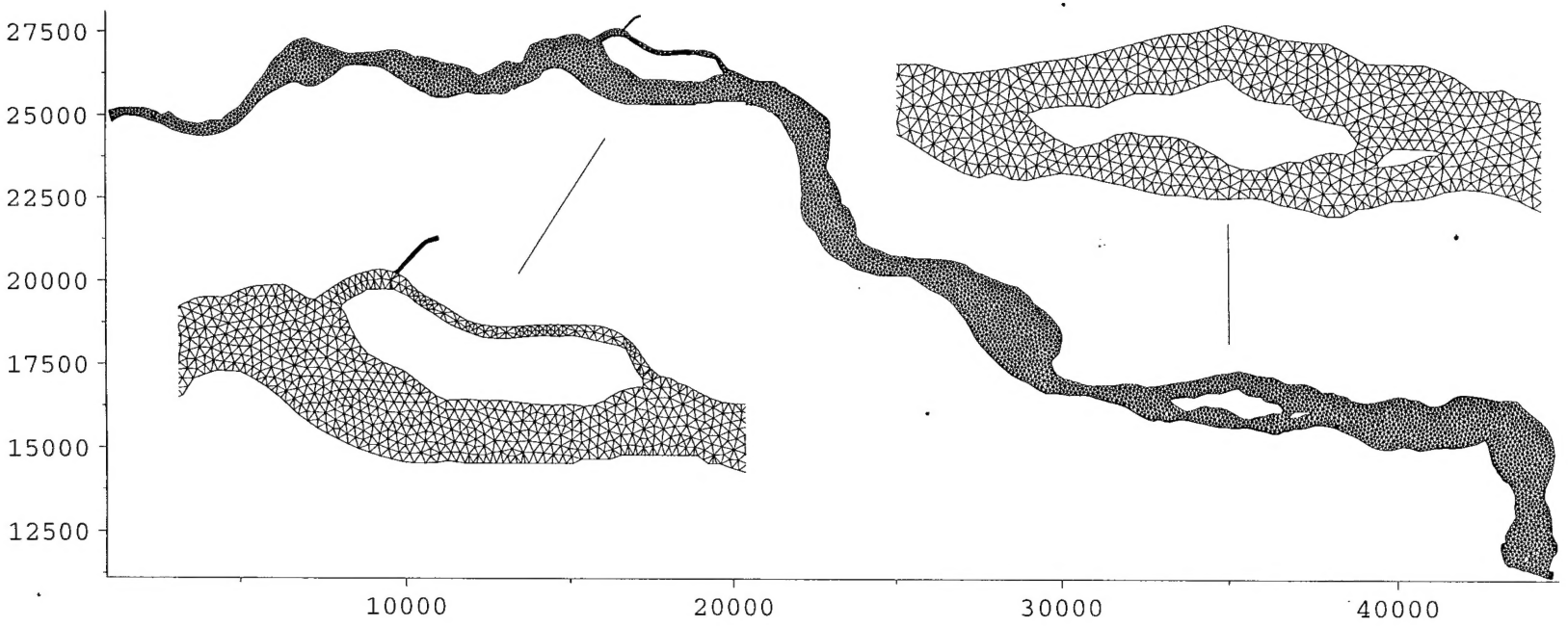
2. Run dynamic simulations for sections of the flow record from summer 1993.

3. Create and run new models of higher resolution in areas of particular interest.

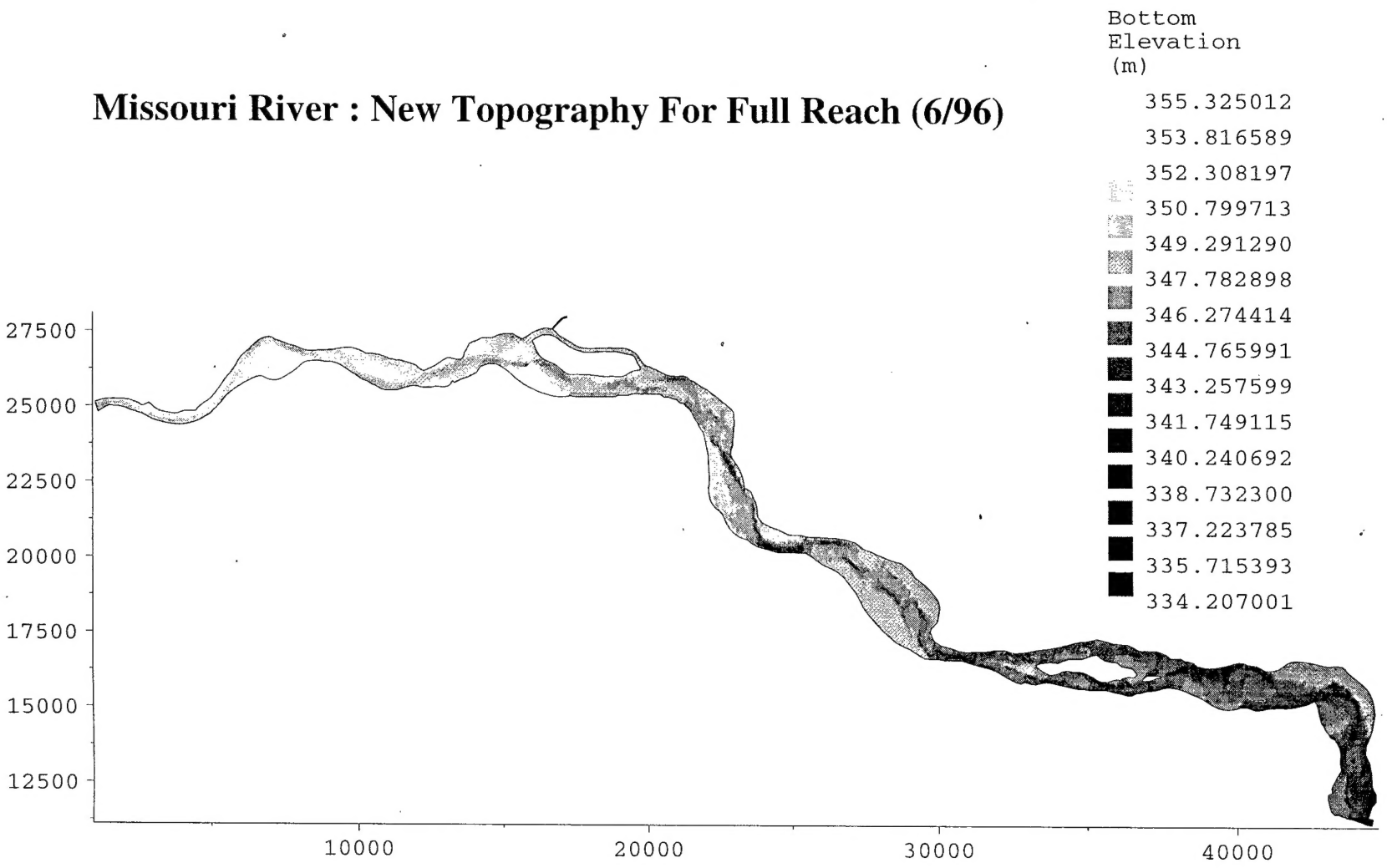
4. Confirm datum level for Maskell gauge site.

Missouri River : New Mesh Following Boundary Changes

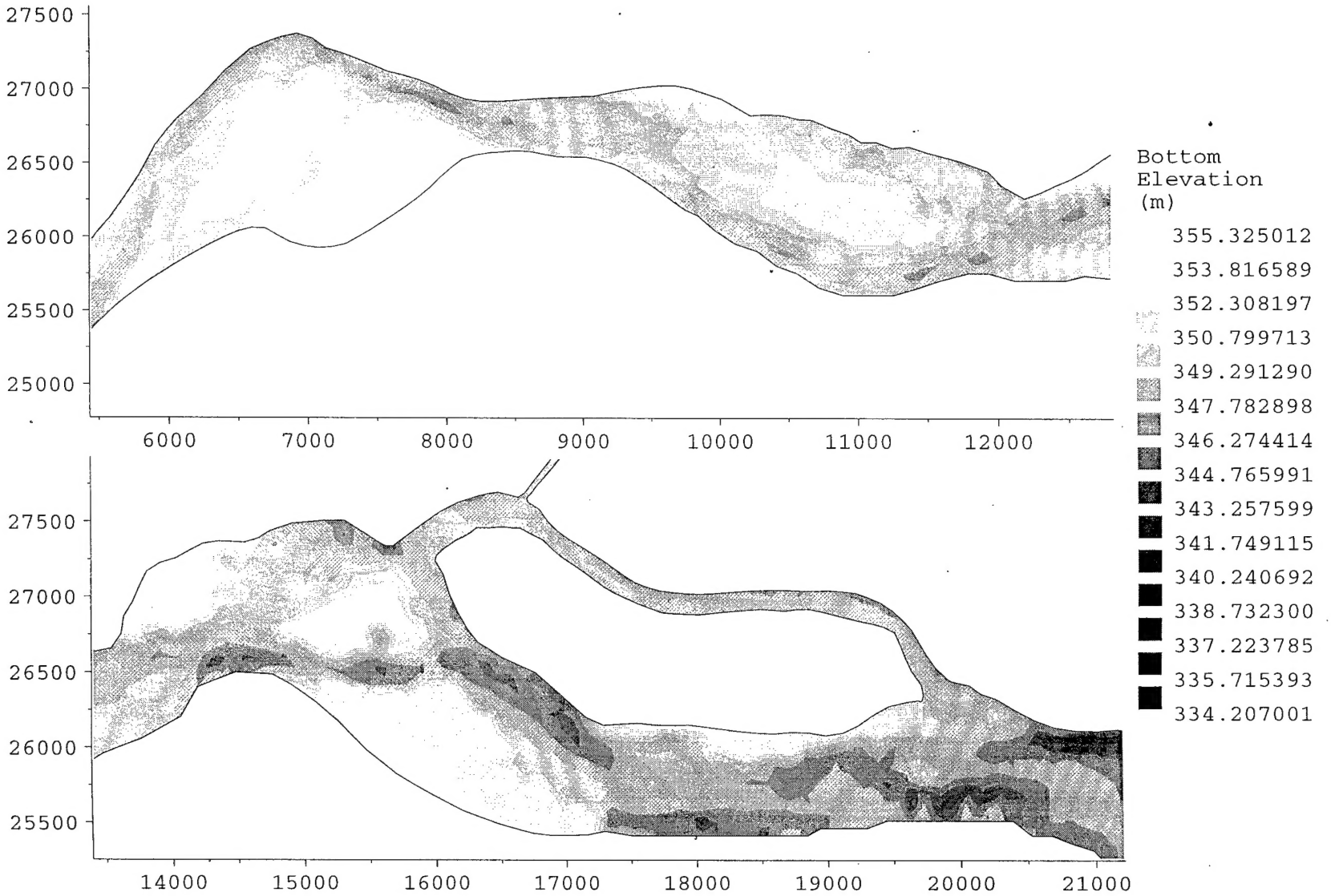
5017 Nodes
8634 Elements



Missouri River : New Topography For Full Reach (6/96)



Missouri River : Highlighted New Topography For Upper Reach (6/96)



Missouri River : Highlighted New Topography For Lower Reach (6/96)